

THE ARCHÆOLOGICAL SIGNIFICANCE OF AN ANCIENT DUNE.

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When solid rock is before us, its history is readily traced, its place in geological sequence determined and its characteristics, lithological and mineralogical, determined beyond dispute, but, when this and associated rocks are reduced to a coarse powder or sand and carried by water or borne by wind hither and yon, it is with difficulty that the earlier chapters of the record of its career can be deciphered. As words accumulate as books due to the winds of doctrine, so, ridges, hillocks and undulating plains are formed when the wind gains access to the sand and rearranges the same *en masse* as the stable fixtures of the region determine. These are transient, necessarily, every shifting of the wind changing the scenery, but traces of some of these phenomena have, by lucky chance, survived every vicissitude and it is possible to discover what remains of a one-time dune that was shaped by the winds blowing over a desert-like plain, and at a time when the ocean water filled the adjacent river valley and the tributary brooks were filled with brackish water due to the inflowing tide, and this at a point now fifty miles inland.

In other words, here in the valley of the Delaware River, at the head of tide water, but where the salt or brackish water now never reaches, is what remains of a dune that formed on the bank of a small creek, now diminished to a brook that itself is reduced almost to the vanishing point during the drought of mid-summer, but has been known to resume its former importance as the result of a cloudburst or of a protracted but less impetuous rainfall.

So changed now are all the conditions of a few thousands of years ago, that it seems hopeless to reconstruct the surrounding country at the time the dune was formed. This is a task, however,

that should never be beyond the capabilities of an archæologist. Such reconstruction is not a side-stepping from facts to fancy, but a confirmatory demonstration relating to the discovery of artifacts.

The plat under consideration is the low-lying termination of a long, rectangular field, mostly at a considerable elevation above the brook that drains a tortuous valley of about five hundred acres. The "dune" area is not distinguishable, at present, from the field of which it forms a part, but until recently was noticeable because of a slight conical elevation, which was the more prominent when not covered with vegetation. The surface soil is a shade lighter than that of the field of which it is a continuation and of finer grain, as indicated by clouds of dust that rise from it when a breeze passes, but which is not forceful enough to equally affect the surrounding surfaces.

This plat, the "dune," if such it be, was deforested about 1770 and since 1800 has been more or less continuously under cultivation. The region hereabout, a plain of thousands of acres, has undergone marked changes since the influx of European settlers, less than three centuries ago. Before that time, it was distinctly one of hills and hollows that have now disappeared. Lands deeded as "swamp" and "meadows" have now lost every vestige of such conditions as these names imply, and only a slightly undulating surface marks what was once highly diversified. This change is due, unquestionably, to deforesting and subsequent cultivation, for a sandy soil, unprotected by vegetation, is necessarily the sport of the elements. Wind and rain attack it viciously at times or playfully, if we may so call it, but the surface is affected by the lightest breeze and the gentlest rain. I have known a strong March wind in seventy-two hours to build up a ridge of sand, a hundred yards long, twelve yards wide and seven feet high; leaving a depression in an adjoining field, from whence the sand was carried deeper by the subtraction of this "dune," of about sixty thousand cubic feet. Again, on August 24, 1877, there was a "cloudburst" here that materially altered the surface in places, although practically all the area was protected by growing crops or weeds, yet tons of sand and gravel were washed from upland fields and carried to the meadows, and a gully through which the present brook flows—the natural out-

let for ordinary drainage—was deepened until the clay underlying the coarse glacial gravel was exposed. The ordinary rains of a season falling on ploughed ground may not have a marked effect, but the rains of centuries tell another story.

A section of this dune, cut to a depth of about six feet, shows the present surface soil of about eight inches and of a brownish color inclining to yellow, and beneath, a thick deposit of yellow sand, or brownish-yellow, which is very compact, of uniform size of grains and without any trace of stratification. This, more than aught else, suggests that it is a wind-blown deposit from some near-by point and subsequently compacted by pressure of an overlying stratum and the slow infiltration of moisture.

This deposit, during severe winters, is frozen, nearly if not quite, its whole depth, but this and the subsequent disappearance of frost does not affect its structure, except to gradually render it more compact.

This yellow sand is but a continuation of the present surface soil, the difference in color being due to stain from the yearly coating of broadcasted barnyard manure and the decomposition of vegetation.

The deposit merges into a greenish sand, of somewhat coarser grain and looser texture, which in turn rests upon coarse gravel and this on the clay—possibly pre-glacial.

This uniform structure of the deposits is not confined to the entire area or the conical hill to which reference has been made. Near the center of it we meet with irregular bands of red clay of varying thickness and of more varying length. This clay is in no sense a continuous deposit of this material as when the Raritan or Pensauken clays were laid down, nor are they derived directly from them. I should say they are due to gradual infiltration when the texture was looser than at present and so a deposit of argillaceous character from overlying sand and the actual surface carried to where the more compact sand checked the water—summer rains and melting snows—and the particles held in suspension were arrested. This once started, the water would be held here, later, until all foreign matter was deposited. Even now, there is very little sand to be found here, that is even approximately clean, and the sand of this

dune clouds the water when thrown into it. This method of band-formation is beautifully shown, where extensive exposures, *i. e.*, of hundreds of square feet, have been made. Deep-lying bands can here be directly connected with the surface, the lines or channels of infiltration or inflowing still to be seen.

Sand is never found where it originated as sand. It is, from the day of its origin, a wanderer until conditions finally imprison it, as with this dune, which was derived from the surrounding area, whether wind or water left it where it is. This, of course, necessitates an open country, for the wind cannot reach the sand when protected by vegetation. It was an open country and a coastal plain in a very literal sense, and it was such at so remote a date, not geologically, but as we measure history, that the water of the brook nearby was salt or brackish, as evidenced by the presence of a marine conchological fauna—*Mya*, *Ostrea*, *Cardium*, and undeterminable fragments. Also four valves, broken, of an *Anadonta* or *Unio* ———; all of which brings us face to face with an antiquity worthy of consideration, as there is also an archæological interest in this dune, in that it contains traces of man's handicraft.

Or, are these traces of man, intrusive objects? The plat under consideration was part of an extensive forest less than two centuries ago; the tree-growth being largely oak, with some chestnut, maple, birch, sour gum, hickory and sassafras. The undergrowth was largely greenbriar (*Smilax rotundifolia*), with some ampelopsis and grape. The ordinary semi-aquatic growths of to-day fringed the brook and in such effective fashion that the water was hidden except in winter.

The annual deposit due to decay of such vegetation is greater than the erosion and has therefore gradually raised the surface of the brook's surroundings; not measurably perhaps, but certainly to some extent during many centuries. That at one time there was an open brook with characteristic fauna is certain, as even now, when the stream is at freshet stage, the mud minnow (*Umba pygmosa*) and crayfish (*Cambarus diogenes*) come from the reaches of the brook nearer the river, where the conditions for aquatic life are favorable throughout the year. It is, however, the one-time tree-growth to which attention should be called, and not

without reason, particularly to the oaks. These are of slow growth, yet reach to the largest dimensions. It is within a short distance from this dune that, until 1869, there stood a white oak (*Quercus alba*) which was twenty-seven feet in circumference, three feet from the ground. It was, unquestionably, at least one thousand years old,¹ but we have no warrant for assuming that this ancient tree was the ancestor of all the white oaks. On the contrary, this forest, when at last felled by the settlers, who sacrificed all beauty to their god, utility, was the remote descendant of a primeval forest growth which began to flourish who shall say when?

If this locally known "Pearson Oak" was the remote descendant, as is logically certain, of *Quercus* I. of the reign of Oaks, or the last of a long line of forest monarchs, then we must ascribe to the forest floor or that soil which in slow course of time accumulated during the period that the "dune" and its surroundings were forested, an antiquity which removes it from the remotely historic to a strictly pre-historic time.

I know of no means of determining when the forest age was ushered in, except that we view it from the point of physical geography, if not really a geological standpoint. The forest growth would not start until the condition of soil was favorable, and, in this instance, a change from a coast-line condition to an inland one and strictly fresh-water upland, quite uninfluenced by the ocean tides. How long then was this change in taking place? Also, when, while an herbaceous flora was in its prime, did tree-growth begin? Was it not until the lesser, annual growths had flourished long enough to spread a thin soil due to decomposed vegetation over the old "dune"? Grasses, more pretentious flowering plants, permanent shrubbery, might well have had a long day of their own, before the overshadowing tree-growth began to encroach on their domain, and there is not a particle of evidence forthcoming that the reign of oaks was not a period of several thousand years.

The result of the forest growth is the formation of "black soil," as it was called by Peter Kalm,² and how long it took a foot or more of it to accumulate is problematical. It was never a period of wholly

¹ See Annual Report, Smithsonian Institution, 1876, p. 260.

² "Travels into North America," London, 1770, Vol. II., p. 19.

undisturbed accumulation. Through every woodland tract there trickles a little brook, and often a stream of considerable width and depth broke the monotony of a forest floor. These would necessarily prevent a uniform accumulation of each season's foliage, a large proportion being carried away, for I have often seen currents of air lift and bear away the dead leaves in a forest and deposit them far from the trees from which they fell. Matted dead leaves are bulky, but when such leaves have lost their identity and become dust, the result is an addition to the accumulating soil not thicker than a sheet of tissue paper. Adding to this the decay of fallen tree trunks, we must still admit that the growth of a forest's black soil is a matter of centuries; that it is one of Nature's slow processes. It was on this floor that the Lenni Lenape dwelt, and for how many generations I think no one will presume to deal in figures. He came and little do we know of his career, save that it was not one of such bestial savagery as has been asserted. The variety of artifacts fashioned by him is evidence of this.

When, in 1678-80, the English settlers began in grim earnest to convert the wilderness into a garden, or destroy beauty in the interests of utility, the forest floor began rapidly to disappear. Where the surface is undulating, and I have seen but slight acreage that might be called "a dead level," the forest floor, when exposed to the weather, is washed or blown off and not worked or washed into the underlying sand. The result of rain, if not violent, is to compact sand and steadily lessen its penetrability. This leads us to a consideration of the suggestion, so frequently made, of the intrusion of objects from the surface: that a grooved axe or polished celt or broken pot or other distinctly "Indian" possession had by chance sunk from the surface where it was lost or intentionally left and reached to a considerable depth in the yellow sands beneath and since its passage, all trace of the track of its intrusion become obliterated. Such disturbance always leaves behind it ineradicable traces. The yellow sands, whether laid down by wind or water action, become arranged in such a way that, if disturbed, no rearrangement on the same lines is practicable. Those who have trenched in such deposits intelligently known instantly when a spot has been disturbed since the original deposition. Nature has not

the power to repair the damage so that it can deceive the observant eye and skilled hand of the experienced archæologist. When a "foreign" object is discovered in the yellow sands, it is recognized at once as part and parcel of the containing bed. If, again, intrusion were possible, why is not pottery found at all depths to which undoubted artifacts occur? Why not the familiar surface finds that collectively we call "Indian relics"? I have gathered probably fifty thousand such objects, and have lingered so long over sand banks and gravel beds that I feel entire confidence in the message they hold out to me, and this intimate association has a significance that is not within the experience of the casual observer, who too frequently is the victim of preconceived ideas. To decipher a sand-bank requires patient labor and constant association and, above all, endless comparisons of one point of view with another. Without this, the digging of a single trench and the gathering of a few score "traces" of man's presence is what the hint is to a practical demonstration. Unfortunately the hint has often led to the most grotesque conclusions, and the fact of man's antiquity been hidden by an array of assertions to the contrary, not one of which has an iota of warrant. I assert without fear of successful contradiction that "Indian" relics do not occur in the yellow sands underlying the forest floor.

The character of the disappearance of the forest floor by rain-wash or wind at once demonstrates that such traces of a people who were forest-dwellers as stone artifacts and pottery would ultimately be left scattered over the surface of the underlying formation, upon which the forest floor had been built up. The greater part of such traces, as axes, celts, spear-points, steatite vessels and pottery would prove too heavy for the gentle action of rain or wind, and *a storm's cataclysmic action would only bury such objects with abundant evidence of how they were buried, so no confusion need arise.* As it is, we find, on the one hand, the relics of the historic Indian with traces of the country's Colonial period, and, on the other, with such traces of the precursor of this forest-dweller as were left upon the surface of the ground when the forest floor began to accumulate, or earlier. No one hesitates to separate the pennies of the English kings from Indian arrow-points, although found together; but upon what basis,

we are asked, is a distinction to be drawn between a chalcedony knife or elaborate gorget and a rude basalt or argillite point with which it is now associated? It has been denied that any such distinction could be drawn and it is curious and significant to know that the vehemence of this insistence is in direct proportion to ignorance of the locality. The conditions that here obtain are favorable to preservation of traces of the sequence of events; very generally they are absent.

To eliminate doubt, when a trench is opened, or where any digging is done, other than systematic trenching, the present surface—in no sense an “Indian” surface—for a reasonable depth is not admitted to be demonstrative as to the age or origin of the artifacts found therein. This zone of doubt I have considered to be the topmost six inches, after removal of the twelve inches of surface that has been continually disturbed by cultivation. Assuming the forest floor to have been twelve inches thick—I have found it considerably more in some localities—then an artifact found some ten inches below the zone of doubt would have been forty inches below the surface if the forest floor still existed. When, then, we consider that this dune, treated by others, as well as by myself, at different points, have exposed pebbles, and some too large to suggest eolian origin as to locality, shells, marine and fresh-water, fragments of bone and artificially produced chips of basalt and argillite, and a few of chert, and completed artifacts.

In my own experience, the position of every object, as exposed, suggested—demonstrated?—that it had not slipped down any crevice, but always with the long axis of its diameter horizontal. This, I believe, is the experience of those who have examined the deposit. Several long, narrow points of basalt or argillite have been recovered and every one was as described, as to position; the deposit suggesting, by reason thereof, water action and the points floated or rolled to their position when found. However this may be, the fact remains, that the dune, assumed to be post-glacial, has a geological antiquity and that it contains traces of man that reach back to the time of its formation.

A few words in conclusion concerning the sand deposits of the neighborhood. As familiar to all, the unimpressionable rock is our

standard of stability and its opposite, the so-called, ever-shifting sands. It is to be noted, however, that extremes are always giving rise to misleading impressions. Rocks are not so resistant as to merit the term "eternal" and many a bed of sand has withstood the changes that time has wrought about them for unnumbered centuries. This has not been duly considered by those geologists who feel at home among the rocks where Nature presents a decipherable script, but omits it where only sand has been accumulated. Because of this extra demand for exertion in solving geological problems, the natural history of sand has been neglected or grotesquely misrepresented.

There is a wide distinction between quick-sand, dunes, and the long level reaches of a sand deposit due to aqueous and not eolian transporting force, that has been shut from the light of day and little affected by the rain that reaches it or frost that penetrates the earth's mat sufficiently to congeal its moisture. There is, too, a vast difference between a sand that has been washed until nearly pure silica and sand with sufficient clay to produce a more or less marked cementation of the mass. Hence it follows that there is a great difference in degree as to the penetrability of a deposit of sand, the clay rendering it resistant in proportion to its presence.

Having considered the dune as such and derived from the immediately adjoining fields, the archæological interest now shifts to a locality about nine hundred yards west of the dune and trenches opened by Messrs. Skinner and Spier. There is in this locality an area of some one thousand acres where sand underlies the present surface soil. It varies considerably, as sand, and suggests that since the original deposition it has had a varied experience, the same agencies not affecting the whole area. Thus, it has given rise to various opinions as to its age and origin, the judgment based upon a single point of examination. That this sand area was at one time the sandy bottom of a shallow arm of the sea is probably true, if not demonstrably so, as I believe, and so gives a clue to the age of the artifacts contained therein; the sequence of event being—as suggested by the late Prof. N. H. Winchell, after an examination of the locality with Mr. Volk and myself, Aug., 1913, and this suggestion he maintained with greater confidence after an exhaustive study of arti-

facts from here, surface-found, from the sands and from the implement-bearing drift gravels, declaring that the changes wrought in the surfaces of these worked stones could only be explained by long submergence in sea water.³

Illustrative of this, July 4, Mr. Albert Moyer, of New York City, and myself, made a section of these sands, and he had the good fortune to expose, by careful paring down of the exposure, a series of objects, all of which are, I think, of artificial origin. The surface soil, twelve inches in depth, was carefully removed and the sand underlying for several inches was considered a zone of doubt and nothing found therein was accepted as indicative of antiquity. Beneath this, the sand was of lighter color, and only moderately compact, but increased in density and where really resistant to the trenching tool, the artifacts were found. Among them was a minute fragment of pottery. This was a little disconcerting, for I have never seen potsherds from these sands and Mr. Volk informs me, he has never, in his many years' experience, found any traces of pottery, even of the rudest pattern. I can only conclude that pre-Wisconsin man was acquainted with the rudiments of the ceramic art.

Probably more effective than rain in changing the conditions of a deposit of sand is the action of frost upon it. This, of course, refers to rain as absorbed and not as a transporting agency. I have known the soil and sand at this point to be frozen to a depth of four feet, while the lowermost of the artifacts found by Mr. Moyer was forty inches below the surface and twenty-two in the compact, undisturbed, clay-cemented sand, so it becomes evident that during many winters of each century since the sand was in its present position and under present conditions, these objects have been frost-bound and then liberated by the springtide warmth. This periodic condition of frost appears only to affect physically but not disturb or displace the containing bed. The upheaval of the surface of a field is only soil deep in its disturbance of the contained pebbles and artifacts. They may be lifted up and let down, but the relative position of these objects, each to the other, is not materially changed

³ See Winchell-Abbott Correspondence—unpublished—at Peabody Museum, Cambridge, Mass.

and there is no significant inhumation of a surface-lying specimen. A notable example of this non-disturbance is shown in caches of chert or basalt blades, which have lain undisturbed near the surface, just as placed by aboriginal man, until cultivation of the soil or other interference by man brought them to light. Again, were frost an inhuming agent, how is it that stone mortars weighing from ten to fifty pounds do not gradually sink with each winter's freezing and thawing? I have passed over these relic-bearing fields when I sank "knee-deep" in the mud, but this pressure of the foot was a matter of twelve or fifteen inches actually and explained by the weight of my body, but a mortar or even a stone axe of five or six pounds ought *gradually* to sink deeper and deeper in sands when the frost has melted, but we never find them at any such depth as the lower compact sand of the "yellow drift," except perhaps in some deep pit, the definition of which is clearly shown by the dark discoloration and unmistakable boundary line. But, there, at such significant depth, we do find rude basalt and argillite artifacts of inconsiderable weight, usually less than an ounce, yet as distinctly the output of man's skill as the most elaborate production of the historic Lenape.

The single explanation of the presence of the characteristic artifacts of the yellow sands lies in the suggestion that they are as old as the containing bed and were made at the time or earlier than its deposition as now obtaining, be the agency of distribution either wind or water. That these traces of early man are intrusive objects is simply impossible, and this applies equally to the palæolithic implements of the Kansas gravel, through which the Wisconsin Ice-age floods have washed the present channel of the Delaware River.